## Name:

## Economics 812 Midterm <br> Prof. Bryan Caplan <br> Spring, 2002

## Instructions:

- You have 2 hours to complete this exam.
- You may use any books, notes, or other materials that you wish, but avoid spending too much time on any one question.
- Partial credit may be awarded on all questions.
- The maximum possible number of points is 150.
- You should have 7 pages, counting this one.


## Part 1: True, False, and Explain (10 points each - 3 for the right answer, and 7 for the explanation)

State whether each of the following nine propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. You and a friend both read the same article in the $A E R$ finding that the minimum wage does not increase unemployment. You both agree that P (article finds minimum wage raises unemployment | the minimum wage really does raise unemployment) $=.75$, and $P$ (article finds minimum wage raises unemployment | the minimum wage really does not raise unemployment)=.25. But the two of you DISAGREE in your final estimates: your P (minimum wage raises unemployment| article's findings)=.9, while your friend sets the same probability at .45 .

True, False, and Explain: Your prior probability that the minimum wage increases unemployment must be exactly double your friend's prior probability that the minimum wage increases unemployment.

## Problems 2 and 3 refer to the following information.

$60 \%$ of all agents in an economy have $U=\ln x+\ln y$, and the other $40 \%$ have $\mathrm{U}=2 \ln \mathrm{x}+\ln \mathrm{y}$. All agents start with 1 unit of x and 1 unit of y .
2. True, False, and Explain: $\frac{p_{x}}{p_{y}}<1.4$.
3. True, False, and Explain: Agents of the first type will buy approximately .155 units of $x$.
4. There are two players in the "Big Brother/Little Brother" game. The players simultaneously decide whether to Read or Play Sports. Player 1 earns a payoff of 10 if he does the SAME thing Player 2 does, and 0 otherwise; Player 2 earns a payoff of 10 if he does the something DIFFERENT than what Player 1 does, and 0 otherwise.

True, False, and Explain: The following normal form accurately represents this game.

|  | Player 2 |  |  |
| :--- | :--- | :--- | :--- |
| Player 1 |  | Read | Play Sports |
|  | Read | 10,0 | 0,10 |
|  | Play Sports | 0,10 | 10,0 |

5. True, False, and Explain: In a game of complete and perfect information, every Nash equilibrium is subgame perfect, and MSNE can never exist.
6. Suppose the Ultimatum Game is played simultaneously rather than sequentially. One player writes down an offer, and the other player writes down a minimum acceptable offer. Both notes are then opened; if Player 1's offer is
greater than or equal to Player 2's minimum acceptable offer, they get Player 1's allocation. Otherwise both players get nothing.

True, False, and Explain: There is only one weakly dominant strategy in this game and one subgame perfection equilibrium, but (assuming players' offers do not have to be whole numbers) an infinity of Nash equilibria.
7. Suppose two bargainers infinitely repeat the following game. Their strategy is to always play Soft as long as both players have always played Soft in the past. If one player ever plays Hard, both of them play the MSNE of the game forever afterwards.

|  |  | Player 2 |  |
| :---: | :---: | :---: | :---: |
| $\begin{aligned} & \stackrel{\rightharpoonup}{\omega} \\ & \frac{\stackrel{\omega}{\mathrm{a}}}{2} \end{aligned}$ |  | Hard | Soft |
|  | Hard | 0,0 | 5,1 |
|  | Soft | 1,5 | 4,4 |

True, False, and Explain: The smallest value of $\beta$ able to sustain cooperation is . 5.
8. N firms are trying to form a stable cartel. One of them makes the following suggestion: "Let's set our cartel price somewhat below the monopoly level. That way, we'll make lower profits every turn, but the incentive to cheat will also be a lot smaller. Moderate collusion will be easier to sustain than full collusion."

True, False, and Explain: Assuming firms play trigger strategies, this reduces the critical value of $\beta$ under both Bertrand and Cournot competition.
9. Suppose there is costless entry and exit in the lobbying/rent-seeking "industry."

True, False, and Explain: Repeated interaction between lobbyists will neither increase nor reduce the total social cost of rent-seeking.

## Part 2: Short Answer

## (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. Democratic governments are often lobbied to extend monopoly protection to various firms. Carefully analyze and diagram the full Kaldor-Hicks efficiency consequences (allocative, productive, lobbying) of this practice if (a) productive efficiency and lobbying ability are perfectly correlated (i.e., the lowest-cost firm always defeats higher-cost rivals in political battles if they spend the same amount), and (b) productive efficiency and lobbying abilities are imperfectly correlated.
2. Why does Landsburg say that "prices are good"? Carefully explain Landsburg's position. What role do the Welfare Theorems and game theory play in his argument?
3. In some graduate economics programs, like the University of Chicago's, the students rarely study cooperatively. In other programs, practically every student belongs to a study group. Some observers attribute this to Chicago's high failure rate and the conditionality of funding on passing first-year exams. Others attribute this to a Chicago "culture." Use game theory to model both of these competing hypotheses. To what extent do your two accounts rely on repeated game considerations?

## Name:

## Economics 812 Midterm <br> Prof. Bryan Caplan <br> Spring, 2003

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- You may use any books, notes, or other materials that you wish, but avoid spending too much time on any one question.
- Partial credit may be awarded on all questions.
- The maximum possible number of points is 150.
- You should have 6 pages, counting this one.


## Part 1: True, False, and Explain (10 points each - 2 for the right answer, and 8 for the explanation)

State whether each of the following nine propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

## Problems 1 and 2 refer to the following information.

1. Agents live for two periods. They are endowed with 1 unit of a consumption good in period 1 and 2 units in period 2 . The period 1 good spoils if not consumed in period 1. There are two types of agents:

Type A: $25 \%$ of the agents have $U=\ln \mathrm{c}_{1}$.
Type B: The other $75 \%$ have $U=\ln \mathrm{C}_{1}+\ln \mathrm{C}_{2}$
True, False, and Explain: The general equilibrium interest rate will exceed 200\%.
2. True, False, and Explain: If the two types of agents did not interact (i.e., there is one island for all of the A's and a different island for all of the B's), the interest rate on $A$ would be positive but the interest rate on $B$ would be negative.
3. True, False, and Explain: The Ultimatum Game can be solved using strict dominance.
4. Two players play a Prisoners' Dilemma game followed by a Hawk-Dove game. Consider the following candidate equilibrium: Both players Cooperate in the first game. Then in the second game:

- If both players Cooperated in the first game, both play Dove.
- If one player Cooperated in game 1 and the other didn't, the Cooperator plays Hawk in game 2 and the other player plays Dove.
- If neither Cooperated in turn 1, both players play the MSNE in turn 2.

True, False, and Explain: You need to know the exact payoffs to determine whether this is a subgame perfect NE.

## Questions 5 and 6 refer to the following information.

Suppose that a store decides whether to cheat or not cheat, and a consumer decides whether to investigate the store's reputation, buy without investigating, or not buy without investigating. Intuitively, if the customer investigates, he is never swindled, but always wastes some time. The cost of investigation is $a>0$.

|  | Investigate | Buy | Don't Buy |
| :--- | :--- | :--- | :--- |
| Cheat | $0,-\mathrm{a}$ | $5,-5$ | 0,0 |
| Don't Cheat | $3,3-\mathrm{a}$ | 3,3 | 0,0 |

5. True, False, and Explain: If a MSNE does not exist, there are two PSNE.
6. True, False, and Explain: If the game is infinitely repeated, the equilibrium (Don't Cheat, Buy) may be sustainable even if $a>5$.
7. True, False, and Explain: If firms have heterogeneous costs, the equilibrium in a one-shot Bertrand game will definitely be more allocatively efficient but may be less productively efficient than a one-shot Cournot game.
8. True, False, and Explain: Landsburg (Fair Play) argues that leaving childbearing decisions to individuals creates a special kind of Prisoners' Dilemma.
9. True, False, and Explain: Repeated game theory provides a solid theoretical explanation for the widely-accepted view that collusion is more common than predation.

## Part 2: Short Answer

 (20 points each)In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. "Journalists seem to think that the costs of foreign competition can be measured by the number of Americans who leave their jobs as a result. That's pretty much the opposite of the truth." (Landsburg, Fair Play)

Use cost-benefit analysis to defend the journalists' position.
2. Explain why the free-entry equilibrium with fixed costs is inefficient in a Cournot game. Is this a realistic prediction? Why or why not? Explain how you would try to break out of this equilibrium if you ran one of the firms.
3. In any long-term friendship, there are multiple equilibria, of which only a small fraction are ever played. Give a good example to illustrate this principle.
Building on Kreps' discussion of "Why Might There Be an Obvious Way to Play a Game?" analyze what makes the observed equilibria "special."

## Name:

## Economics 812 Midterm <br> Prof. Bryan Caplan <br> Spring, 2004

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- Partial credit may be awarded on all questions.
- The maximum possible number of points is 150.
- You should have 6 pages, counting this one.


# Part 1: True, False, and Explain (10 points each - 2 for the right answer, and 8 for the explanation) State whether each of the following nine propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer. <br> 1. Suppose a million new immigrants enter the U.S., driving down the wages of low-skilled Americans by $\$ 1 /$ hour. <br> True, False, and Explain: According to Landsburg (Fair Play), this change usually increases Kaldor-Hicks efficiency, because the positive effect of population growth on innovation tends to outweigh the negative externality of falling wages. 

2. Two types of agents consume guns (g) and butter (b). The Type A agents have $U=.5 \ln g+.5 \ln b$, and initially own 1 unit of guns and 1 unit of butter. The Type $B$ agents have $U=.3 \ln g+.7 \ln b$, and initially own .5 units of guns and .5 units of butter. 10\% of the agents are Type A; the other $90 \%$ are Type B.

True, False, and Explain: The price of guns will not equal the price of butter.
3. True, False, and Explain: If everyone has lexicographic preferences for $\mathbf{x}$ over $y$, the conclusion of the First Welfare Theorem holds even though its assumptions do not.
4. Consider the following 2-player game:

|  | Up | Down |
| :--- | :--- | :--- |
| Left | 0,0 | 0,0 |
| Right | 0,0 | 0,0 |

True, False, and Explain: This game has 4 PSNE but no MSNE.

Questions 5 and 6 refer to the following information.
Suppose that two players repeatedly play the following game.

|  | Hawk | Dove |
| :--- | :--- | :--- |
| Hawk | $-10,-10$ | 5,0 |
| Dove | 0,5 | 3,3 |

5. True, False, and Explain: If the game is repeated infinitely, trigger strategies can sustain the socially optimal outcome as long as $\beta>.6$
6. True, False, and Explain: If the game is repeated twice, $\beta=1$, and players get to flip a coin after turn 1, there is no NE where players play (Dove, Dove) in turn 1.
7. Suppose there is a Cournot industry with the demand function $\mathrm{Q}=\mathrm{a}-\mathrm{bP}, 8$ firms, 0 MC, and no fixed cost.

True, False, and Explain: A firm would want to split into two firms because it would earn 62\% more profit as a result.
8. True, False, and Explain: Kreps argues that in the "noisy" real world, trigger strategies are not a practical way to sustain collusion. Instead, colluding firms would only punish if prices were significantly below the agreed level.
9. Suppose firms in an industry have fixed costs and increasing marginal costs. The industry demand curve lies strictly above firms' AC curves.

True, False, and Explain: Bertrand competition will allow only one firm to survive in this market, implying no productive inefficiency but some allocative inefficiency.

## Part 2: Short Answer <br> (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. "The assumptions of the Arrow-Debreu model are sufficient but not necessary conditions for the efficiency of laissez-faire."

Discuss this statement, using two specific examples from game theory to illustrate your point.
2. Use Tullock's insights on rent-seeking to analyze students' allocation of effort between studying and cheating. What changes if students can bribe professors for better grades?
3. Suppose you have a 2-player version of the voluntary donation game from the notes, with one difference: Each agent cares somewhat about the other, so player one maximizes $U_{1}=c_{1} D+.5^{*} \mathrm{C}_{2} \mathrm{D}$, and player two maximizes $\mathrm{U}_{2}=\mathrm{C}_{2} \mathrm{D}+.5^{*} \mathrm{c}_{1} \mathrm{D}$. Carefully set up each player's maximization problem. Then solve for the symmetric Nash equilibrium.

## Name:

## Economics 812 Midterm <br> Prof. Bryan Caplan <br> Spring, 2005

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- Partial credit may be awarded on all questions.
- The maximum possible number of points is 150.
- You should have 6 pages, counting this one.


## Part 1: True, False, and Explain (10 points each - 2 for the right answer, and 8 for the explanation)

 State whether each of the following nine propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.1. A special medical test always detects the presence of a disease if a person has it; however, $5 \%$ of perfectly healthy people will test positive as well (there is a $5 \%$ "false positive" rate). Suppose that . $1 \%$ of people actually have the disease, and that members of the population are tested at random.

True, False, and Explain: The approximate conditional probability of having the disease given the fact that you test positive is $95 \%$. (Hint: Remember Bayes Rule!)
2. Two types of agents consume guns (g) and butter (b). The Type A agents have $U=.5 \mathrm{~g}+.5 \mathrm{~b}$. The Type B agents have $\mathrm{U}=.3 \mathrm{~g}+.7 \mathrm{~b}$. All agents initially own 1 unit of guns and 1 unit of butter. $50 \%$ of the agents are type A; 50\% are type B.

True, False, and Explain: General equilibrium does not exist because the agents' demand functions are discontinuous in price.

## 3. True, False, and Explain: In a Coordination game, Pareto-inferior equilibria are not subgame perfect.

4. True, False, and Explain: Landsburg's "Indifference Principle" (The Armchair Economist) is inconsistent with the concept of the MSNE.
5. Consider the following 2-player game:

|  | Up | Down |
| :--- | :--- | :--- |
| Left | 10,0 | 10,0 |
| Right | 0,10 | 0,10 |

True, False, and Explain: This game has no PSNE and one MSNE.

## Questions 6 and 7 refer to the following information.

Suppose that two players play an Ultimatum game where Player 1 divides a payoff of 10 between himself and Player 2. Then the players play the following Hawk-Dove game ONCE. Players do not discount the future ( $\beta=1$ ).

|  | Hawk | Dove |
| :--- | :--- | :--- |
| Hawk | $-10,-10$ | 5,0 |
| Dove | 0,5 | 3,3 |

6. True, False, and Explain: An even split (5/5) in the Ultimatum game is a focal point but cannot be a SGPNE.
7. True, False, and Explain: If the players play the Hawk-Dove game first, and the Ultimatum game second, exactly two SGPPSNE exist.
8. True, False, and Explain: According to Kreps, game theory rules out the possibility that "cheap-talk" can affect games' outcomes.
9. Suppose the demand curve for a contestable monopoly crosses the AC curve at more than one point.

True, False, and Explain: There are multiple equilibria.

## Part 2: Short Answer

## (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. Suppose:

- $40 \%$ of all agents (the Type As) in an economy have $U=\ln x+\ln y$, and the other $60 \%$ (the Type Bs) have $U=3 \ln x+\ln y$.
- All agents start with one unit of $x$ and one unit of $y$.

How will redistribution of x from As to Bs affect the general equilibrium $\frac{p_{x}}{p_{y}}$ ?
Write down the formula for $\frac{p_{x}}{p_{y}}$, using $\bar{x}$ to indicate the quantity of x you let the Type As keep. (Hint: Remember hw\#2, problem 4!)
2. What kind of a bargainer are you? Why? Explain your typical strategies in game theoretic terms. Are there any focal points that you frequently rely on?
3. Suppose an Incumbent infinitely repeats the following entry deterrence game.

Suppose that in order to have a reputation for Fighting, an Incumbent must be willing to accept the (In, Fight) result for one turn. (After that turn, he earns the (Out, Fight) payoff forever). Write down the inequality the Incumbent must satisfy to have this reputation. Then solve for the critical value of $\beta$.

## Name:

## Economics 812 Midterm <br> Prof. Bryan Caplan <br> Spring, 2006

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- You should have 6 pages, counting this one.

Part 1: True, False, and Explain<br>(10 points each - 2 for the right answer, and 8 for the explanation)

State whether each of the following nine propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. Situation $A$ is a Kaldor-Hicks improvement over Situation B. Situation $A$ is Pareto efficient.

True, False, and Explain: Situation A must also be Kaldor-Hicks efficient.
2. Suppose $50 \%$ of all agents are certain $(p=1)$ that occupation of Iraq will reduce terrorism, and $50 \%$ of all agents are certain $(p=1)$ that occupation of Iraq will increase terrorism. A betting market exists where agents can bet on their beliefs.

True, False, and Explain: A general equilibrium can only exist if the prices of the two bets are equal.
3. True, False, and Explain: According to Kreps, economic experiments confirm that general equilibrium analysis has little predictive value.

Questions 4 and 5 refer to the following game:

|  | Left | Right |
| :--- | :--- | :--- |
| Left | 2,1 | 0,0 |
| Right | 0,0 | 1,2 |

4. This game has a MSNE with expected payoffs equal to (1.5, 1.5).
5. True, False, and Explain: Played simultaneously, this game has two SGPPSNE. Played sequentially (with Player 1 moving first), this game has two PSNE, but only one is SGP.
6. Suppose there are two firms able to produce a good. Firm \#1 has TC=\$1000 + \$0Q; Firm \#2 has TC=\$0 + \$10Q.

True, False, and Explain: If demand goes up high enough, Firm \#1 will drop out of the market and Firm \#2 will set its price just below Firm \#1's AC.
7. True, False, and Explain: If firms set prices (as opposed to quantities), firms would never want to split into additional firms, even if the game were infinitely repeated and $\beta=1$.
8. N players are deciding whether to contribute to a public good. The public good is discrete: it is produced at the optimal level so long as 1 person contributes. Contributing costs the individual who contributes C , and 0 otherwise. If the public good is produced, everyone gets a benefit of $B$; otherwise they get a benefit of 0 . $B>C$.

True, False, and Explain: There are two PSNE, only one of which is KaldorHicks efficient.
9. In Leviathan, Hobbes argues that, in the absence of government, individuals always prefer war to peace, leading to a "war of all against all" equilibrium.

True, False, and Explain: This precisely what the Hawk/Dove game predicts.

## Part 2: Short Answer

(20 points each)
In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. Give an example of lexicographic preferences. How can lexicographic preferences preclude the existence of a general equilibrium? Is it possible for a general equilibrium to exist given the existence of lexicographic preferences? Explain.
2. Coordination equilibria are often persistent, but they also change. Give a real-world example. Then use game theory to explain how this change happened, paying particularly close attention to the incentives of the "firstmovers."
3. Landsburg (The Armchair Economist) argues that laws restricting cosmetic surgery are an inefficient restriction on competition. Using the game theory you have learned so far, present and defend what you see as the strongest possible counter-argument to Landsburg's claim. (You don't have to agree with your argument; just present it as forcefully as possible).

## Name:

## Economics 812 Midterm <br> Prof. Bryan Caplan <br> Spring, 2007

## Instructions:

- You have 2 hours to complete this exam.
- You may use any books, notes, or other materials that you wish, but avoid spending too much time on any one question.
- Partial credit may be awarded on all questions.
- The maximum possible number of points is 150.
- You should have 6 pages, counting this one.

Part 1: True, False, and Explain (10 points each - 2 for the right answer, and 8 for the explanation) State whether each of the following nine propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. True, False, and Explain: One benefit of the war on drugs that Landsburg's efficiency analysis overlooks is the salaries paid to the extra government employees required to enforce these laws.
2. True, False, and Explain: Contestable monopoly leads to "second-best" efficient outcomes, whereas Bertrand competition leads to "first-best" efficient outcomes.
3. There are two islands with equal numbers of agents. All agents live for two periods and are endowed with 1 unit of a consumption good in period 1 and 1 unit in period 2. The period 1 good spoils if not consumed in period 1. On the Island \#1, agents have $U=\ln \mathrm{c}_{1}$; on Island $\# 2$, agents have $U=\ln \mathrm{C}_{1}+\ln \mathrm{c}_{2}$.

True, False, and Explain: If trade between islands is possible, the interest rate will exceed $50 \%$. If trade between islands is not possible, the interest rate on Island \#1 will exceed the interest rate on Island \#2 by less than 100 percentage-points.

Questions 4 and 5 refer to the following game:

|  | Trust | Doubt |
| :--- | :--- | :--- |
| Truth | 2,2 | 0,0 |
| Lie | $4,-2$ | $-2,0$ |

4. This game has two PSNE, plus a MSNE where players play (Truth, Trust) with probabilities (.5,.5).
5. Suppose both players have a discount rate, $\beta=1$, and play this game twice.

True, False, and Explain: There is a NE where players play (Truth, Trust) in the first turn, and the MSNE of the one-shot game in the second turn.
6. Two players play an Ultimatum game, followed by a Coordination game.

True, False, and Explain: There are an infinite number of SGPPSNE, some of which have a $50 / 50$ split in the first turn.
7. Suppose there are two firms able to produce a good. Firm \#1 has TC=\$50 + $\$ 0 \mathrm{Q}$; Firm \#2 has $\mathrm{TC}=\$ 0+\$ 10 \mathrm{Q}$. The demand curve is given by $\mathrm{Q}=20-\mathrm{P}$.

True, False, and Explain: Firm \#1 will drop out of the market and Firm \#2 will charge the monopoly price.
8. Suppose two Bertrand competitors collude in an infinitely-repeated game, but the first firm insists on getting the "lion's share" of the profits. The first firm gets $90 \%$ of the monopoly profits. The second firm gets the remaining $10 \%$.

True, False, and Explain: This is a NE as long as $\beta \geq .1$ for both firms.
9. Satellite television has enormous fixed costs, but near-zero marginal costs. Suppose the current market structure, where two firms (Dish Network and Direct TV) supply satellite television, was the outcome of Cournot competition with free entry. Suppose further that no additional entry is legally allowed.

True, False, and Explain: A merger to monopoly will increase productive efficiency, hurt allocative efficiency, and decrease overall efficiency.

## Part 2: Short Answer <br> (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. "As with other fundamentals of action, doubts about probability are self-refuting." (Caplan, "Probability, Common Sense, and Realism.") Carefully explain Caplan's argument. Is he right?
2. N players are deciding whether to contribute to a public good. The public good is discrete: it is produced at the optimal level so long as one person contributes. If the public good is produced, everyone gets a benefit of 3 if they didn't contribute, and 2 if they did. If no one contributes, everyone gets 0 . Find the MSNE. When is the MSNE Kaldor-Hicks efficient?
(Hint: If $p$ is the probability that one player contributes, the probability that no other player contributes equals $(1-p)^{N-1}$, and the probability that at least one other player contributes is $\left.1-(1-p)^{N-1}\right)$.
3. Throughout history, the usual system has been for heads of state (such as kings) to serve for life. In modern times, however, heads of state often leave office voluntarily long before their deaths. Using all of the game theory you have learned, provide the best possible explanation for both of these patterns. Why has there been a transition from one pattern to the other?

## Name:

## Economics 812 Midterm <br> Prof. Bryan Caplan <br> Spring, 2008

## Instructions:

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- Write directly on the exam!
- You may use any books, notes, or other materials that you wish, but avoid spending too much time on any one question.
- Partial credit may be awarded on all questions.
- The maximum possible number of points is 150.
- You should have 6 pages, counting this one.


# Part 1: True, False, and Explain <br> (10 points each - 2 for the right answer, and 8 for the explanation) 

State whether each of the following nine propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. Suppose your P (more abortions cause less crime) $=.4, \mathrm{P}$ (Levitt's research results | more abortions cause less crime)=.6, and $P$ (more abortions cause less crime | Levitt's research results)=.8.

True, False, and Explain: If you satisfy Bayes' Rule, your P(Levitt's research results | more abortions don't cause less crime) must be .1.
2. True, False, and Explain: If a state of affairs is Pareto efficient, then deadweight costs must be zero.
3. Suppose you have a betting market where half the participants are certain that Clinton will win the Democratic nomination, and the other half are certain that Obama will win.

True, False, and Explain: A general equilibrium will not exist.
4. Suppose a pirate robs ten people and puts all of their money inside a treasure chest. When the police recover the chest (and before the pirate can spend a penny), they ask each of the ten victims to state how much money he lost. To discourage lying, the police announce that if the total losses claimed by the victims exceeds the total amount of money in the chest, none of the victims will get any money back.

True, False, and Explain: There is a unique NE in which every victim says the truth.
5. Suppose that two players play this PD game, followed by this Coordination game.

|  | Don't | Defect |
| :--- | :--- | :--- |
| Don't | 3,3 | 0,4 |
| Defect | 4,0 | 2,2 |


|  | L | R |
| :--- | :--- | :--- |
| L | 5,5 | 0,0 |
| R | 0,0 | 5,5 |

## True, False, and Explain: If $\beta=.5$, the only SGPNE are (Defect, Defect), (L,L) and (Defect, Defect), (R, R).

6. "If your rival(s) suspect that you are not rational, or even if they suspect that you suspect that they suspect that you aren't rational, then the 'rational' actions for you can be quite different than if you ignore this possibility." (Kreps, A Course in Microeconomic Theory)

True, False, and Explain: This point explains why threatening to fail students for leaving early does not work in the real world.
7. Suppose that two firms flip a coin, then play a contestable monopoly game with sunk costs.

True, False, and Explain: The coin flip allows the firms to raise their expected profits, even though the set of equilibria in the contestable monopoly game does not change.
8. True, False, and Explain: In a market with perfectly selfish consumers and producers, the existence of a public good implies both allocative and productive inefficiency.
9. Suppose that two firms compete in a market with linear demand and zero costs.

True, False, and Explain: Collusion is easier to sustain in the Cournot model than it is in the Bertrand model.

## Part 2: Short Answer

## (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. Suppose country A has 1000 skilled workers and 1000 unskilled workers, and country B has 0 skilled workers and 10,000 unskilled workers. Both countries initially prohibit all immigration. Build on the Second Welfare Theorem to propose a Pareto-improving policy reform.
2. Why does popcorn cost more at movies - and how is this possible in a market with free entry? If you give an answer that Landsburg rejects, you must explain why he is wrong to reject your answer.
3. Suppose two strangers meet on a desert island. Is mutual warfare a NE? A likely NE? A unique NE? Use all of the game theory you have learned - and common sense - to answer the question.

## Name:

## Economics 812 Midterm <br> Prof. Bryan Caplan <br> Spring, 2009

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- The maximum possible number of points is 150 .
- You should have 6 pages, counting this one.

> Part 1: True, False, and Explain (10 points each - 2 for the right answer, and 8 for the explanation) State whether each of the following nine propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.
> 1. True, False, and Explain: In practice, ex ante Pareto efficiency is equivalent to Kaldor-Hicks efficiency, because in the long-run, the benefits of allowing uncompensated Kaldor-Hicks improvements more than cancel out the losses.

## Problems 2 and 3 refer to the following information.

2. Agents live for two periods. They are endowed with 1 unit of a consumption good in period 1 and 2 units in period 2 . The period 1 good spoils if not consumed in period 1. There are two types of agents:

Type A: $10 \%$ of the agents have $U=\ln \mathrm{c}_{2}$.
Type B: The other $90 \%$ have $U=\ln \mathrm{c}_{1}+\ln \mathrm{c}_{2}$
True, False, and Explain: The general equilibrium interest rate will exceed 200\%.
3. True, False, and Explain: If the two types of agents do not interact (i.e., there is one island for all of the A's and a different island for all of the B's), the interest rate on $A$ will be positive but the interest rate on $B$ will be negative.
4. Consider the following normal form:

|  | Left | Right |
| :--- | :--- | :--- |
| Left | 2,2 | 0,0 |
| Right | 0,0 | 0,0 |

True, False, and Explain: This game has one PSNE and one MSNE, but it can be solved through weak dominance.

## Problems 5 and 6 refer to the following information.

Kreps imagines a monopolist's monologue:
Out there are many people who would enter this industry and take away my profits if they thought they that they could themselves make a profit... My choice of an output level of 5 may look silly in the short run, but if it keeps you (and other potential entrants) out of my market, it is a good strategy to employ.
5. True, False, and Explain: Kreps' monopolist engages in "limit pricing."
6. Kreps adds, "Now rather a lot is wrong with the story just told..."

True, False, and Explain: The monopolist's story might be OK in a repeated game IF there are also sunk costs.
7. Suppose two players play the following normal form $N$ times. $N$ is finite and known by both players.

|  | Left | Right |
| :--- | :--- | :--- |
| Left | 5,1 | 0,0 |
| Right | 0,0 | 1,5 |

True, False, and Explain: Alternating back and forth between (L,L) and (R,R) is an equilibrium as long as $N$ is even and $\beta \geq 5 / 6$.
8. Consider a Cournot model with two firms. $P=10-Q$, and $M C=0$.

True, False, and Explain: If one firm moves first, the unique SGPNE has a higher $\mathbf{Q}$ than it does with simultaneous play.
9. True, False, and Explain: The War/Peace game confirms the view that the invention of atomic weapons reduced the risks of war and human extinction.

## Part 2: Short Answer

## (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. People occasionally argue that Western consumers are virtually "satiated" before long, they will have everything they want. Assume this claim is correct, and that labor productivity continues to improve. Describe the general equilibrium consequences for output, employment, wages, and real interest rates. Carefully explain your reasoning.
2. People (including economists) often think that monopolies are productively inefficient. Why, on reflection, would this be strange? What additional assumptions do you need to make the "inefficient monopolies" story internally consistent?
3. If Landsburg's "People Wanted," (Fair Play) is correct, does Kaldor-Hicks efficiency require the long-run maximization of population? Carefully explain your answer, staying as close as possible to Landsburg's descriptive claims about the economic consequences of population growth.

## Name:

## Economics 812 Midterm

Prof. Bryan Caplan
Spring, 2010

## Instructions:

- You have 1 hour, 40 minutes to complete this exam.
- Write directly on the exam!
- You may use any books, notes, or other materials that you wish, but avoid spending too much time on any one question.
- Partial credit may be awarded on all questions.
- The maximum possible number of points is 120 .
- You should have 5 pages, counting this one.


## Part 1: True, False, and Explain (10 points each - 2 for the right answer, and 8 for the explanation) State whether each of the following nine propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer. <br> 1. True, False, and Explain: Landsburg's Indifference Principle undermines the standard efficiency rationale for taxing negative externalities.

2. Two types of agents consume guns (g) and butter (b). The Type A agents have $\mathrm{U}=.5 \mathrm{In} \mathrm{g}+.5 \mathrm{In} \mathrm{b}$, and initially own 10 units of guns and 10 units of butter. The Type B agents have $\mathrm{U}=.3 \ln \mathrm{~g}+.7 \ln \mathrm{~b}$, and initially own nothing. $10 \%$ of the agents are Type A; the other $90 \%$ are Type B.

True, False, and Explain: The equilibrium price of guns will equal the equilibrium price of butter.
3. True, False, and Explain: In an Ultimatum game, a $50 / 50$ split is the only SGPPSNE; in a Dictator game, a 100/0 split is the only SGPPSNE.
4. Landsburg says that the "obvious" explanation for why popcorn costs more at movies is wrong.

True, False, and Explain: The problem with "obvious" explanation, according to Landsburg, is that even the simplest monopoly problem has multiple NE.
5. Suppose you have the following Hawk/Dove game. Players do not discount the future. In the one shot game, the two players flip a coin to decide who plays Hawk and who plays Dove.

|  |  | Player 2 |  |
| :---: | :---: | :---: | :---: |
| $\begin{aligned} & \overline{\mathrm{O}} \\ & \frac{\bar{\sigma}}{\mathrm{C}} \end{aligned}$ |  | Hawk | Dove |
|  | Hawk | -100,-100 | 5,1 |
|  | Dove | 1,5 | 4,4 |

## True, False, and Explain: If they play this game twice, the players can both on average earn more per turn than they would in the one-shot game.

6. Suppose the government gives one car manufacturer a monopoly privilege. The lobbying process leads to full rent dissipation. Each firm has the same constant marginal cost of production, and demand is linear.

True, False, and Explain: Deadweight costs fall when demand falls or firms' costs increase.

## Part 2: Short Answer <br> (20 points each) <br> In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. Consider a Cournot model with two firms. $\mathrm{P}=10-\mathrm{Q}$, and Total Cost=K for each firm. In equilibrium, all firms that produce must be profitable, and all firms that can profitably produce do so. Graph market price as a function of K . Explain your reasoning.
2. In the real world, why don't reputational incentives eliminate all fraud?
3. "Free market economists typically express confidence in the ability of markets to produce public goods... At the same time, free market economists tend to be pessimistic about the stability of cartels in an unregulated market. If markets successfully produce local public goods, however, why are stable cartels not more prevalent?" (Cowen and Sutter 1999)

Explain Cowen and Sutter's argument using basic game theory. Does it make sense in the real world? Why or why not?

## Name:

## Economics 812 Midterm <br> Prof. Bryan Caplan <br> Spring, 2011

## Instructions:

- You have 1 hour, 40 minutes to complete this exam.
- Write directly on the exam!
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- Partial credit may be awarded on all questions.
- The maximum possible number of points is 120 .
- You should have 5 pages, counting this one.


## Part 1: True, False, and Explain <br> (10 points each - 2 for the right answer, and 8 for the explanation)

State whether each of the following six propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. Two types of agents live for two periods. In each period, they receive an endowment of perishable consumption goods - storage over time is not possible. Type $A$ agents have $U=\ln c_{1}+B \ln c_{2}$; Type $B$ agents have $U=\ln C_{1}+\rho \ln c_{2}$. Both types of agents are equally numerous and have endowments of 1 in each period.

True, False, and Explain: The equilibrium interest rate requals $2 /(\beta+\rho)$.
2. Consider the following normal form:

|  | Left | Right |
| :--- | :--- | :--- |
| Left | 1,1 | 0,0 |
| Right | 0,0 | 2,2 |

True, False, and Explain: If two players play this game sequentially, there are three NE but only one SGPNE.

## Questions 3 and 4 refer to the following information:

An Incumbent and an Entrant infinitely repeat the following game.

|  | Enter | Don't Enter |
| :--- | :--- | :--- |
| Predate | $-10,-10$ | 10,0 |
| Don't Predate | 2,2 | 10,0 |

Consider the candidate equilibrium where the Incumbent always plays Don't Predate, and the Entrant plays Enter until the Incumbent plays Predate once. After the Incumbent plays Predate, the Entrant never plays Enter again.
3. True, False, and Explain: This is not a NE unless the Incumbent's discount factor is less than .6.
4. Suppose that every turn, there is a $p>0$ that the entire industry disappears due to exogenous technological innovation.

True, False, and Explain: Predation may still be sustainable.
5. True, False, and Explain: Bertrand competition between identical firms with fixed costs yields a second-best efficient outcome.
6. Consider the following one-shot game:

|  | Attack | Submit | Defend |
| :--- | :--- | :--- | :--- |
| Attack | $-10,-10$ | $5,-3$ | $-20,-5$ |
| Submit | $-3,5$ | 0,0 | $0,-1$ |
| Defend | $-5,-20$ | $-1,0$ | $-1,-1$ |

True, False, and Explain: There is a MSNE, but no PSNE.

## Part 2: Short Answer

## (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. "People may be unable to articulate, for example, that 'I would be willing to pay $\$ 200$ per month in additional rent to live in a safer neighborhood.' They might even nonsensically assert that 'You can't put a price on safety.' But in acting, they implicitly make such trade-offs." (Caplan, "Probability, Common Sense, and Realism")

What objection to probability theory is Caplan trying to answer? Does he succeed?
2. Modify the Hawk/Dove game to explain why in the real world - unlike Thomas Hobbes' Leviathan - two shipwrecked people are unlikely to try to murder each other. Carefully explain why your model is a good description of the choices and payoffs that human beings would actually face in this situation.
3. With full rent dissipation, roughly what would U.S. rent-seeking as a percentage of GDP be? Is this a reasonable estimate of actual U.S. rentseeking as a percentage of GDP? If not, what is the best explanation for the discrepancy?

## Name:

## Economics 812 Midterm

Prof. Bryan Caplan
Spring, 2012

## Instructions:

- You have 1 hour, 40 minutes to complete this exam.
- Write directly on the exam!
- You may use any books, notes, or other materials that you wish, but avoid spending too much time on any one question.
- Partial credit may be awarded on all questions.
- The maximum possible number of points is 120 .
- You should have 5 pages, counting this one.


## Part 1: True, False, and Explain

(10 points each - 2 for the right answer, and 8 for the explanation)
State whether each of the following six propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. Let "CK"="the results of the Card-Krueger minimum wage study." Suppose the p (econometrics is reliable $)=.8, \mathrm{p}(\mathrm{CK} \mid$ econometrics is reliable $)=.3$, and $\mathrm{p}(\sim \mathrm{CK} \mid$ econometrics is reliable) $=.7$.

True, False, and Explain: $\mathbf{P}$ (econometrics is reliable|CK)>70\%.

Questions 2 and 3 refer to the following information:
Bryan, Tyler, and John play a game with three possible strategies: Comics, Chess, and Opera. Their payoffs are:

|  | Bryan | Tyler | John |
| :--- | :--- | :--- | :--- |
| Everyone Plays Comics | 10 | 1 | 2 |
| Everyone Plays Chess | 1 | 5 | 5 |
| Everyone Plays Opera | 4 | 4 | 4 |
| All Other Cases | 0 | 0 | 0 |

2. True, False, and Explain: This game has one PSNE if the players play sequentially, but three PSNE if the players play simultaneously.
3. A MSNE also exists.

True, False, and Explain: In this MSNE, Tyler is indifferent when:
$P(\text { Bryan plays Comics })^{* P(J o h n ~ p l a y s ~ C o m i c s) ~}=P\left(\right.$ Bryan plays Chess) ${ }^{* P(\text { (John plays Chess) })=}$ $\mathbf{P}$ (Bryan plays Opera) ${ }^{*}$ P(John plays Opera)
4. Consider a simple contestable monopoly model where an incumbent faces an equally productively efficient potential entrant. Both have constant marginal costs and zero fixed costs of production. Both firms know that there is a probability $p$ that - if the incumbent remains in business - the government will prosecute the incumbent for antitrust violations. If this occurs, the incumbent loses a fixed cost K. The entrant never faces antitrust prosecution.

True, False, and Explain: Equilibrium quantity is decreasing in both pand K.
5. True, False, and Explain: With zero costs of production, Kreps (A Course in Microeconomic Theory) shows that consumers are better off in a Stackelberg equilibrium than a Cournot equilibrium.
6. Consider the following one-shot game:

|  | Attack | Submit |
| :--- | :--- | :--- |
| Attack | $-1,-1000$ | 100,1 |
| Submit | 1,100 | 50,50 |

True, False, and Explain: There are two PSNE and one MSNE, but only (Attack, Submit) is focal.

## Part 2: Short Answer <br> (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. Are any of the main assumptions of general equilibrium theory true in the real world? Carefully explain your answer.
2. Why does popcorn cost more at movies? You should either (a) offer an answer Landsburg fails to consider in The Armchair Economist, or (b) argue that Landsburg prematurely rejects the right answer.
3. Compare the maximum deadweight costs of a government grant of monopoly to the deadweight costs of outright prohibition of a product. How would your answer change for a product with negative externalities? Use graphs to clarify your answer.

## Name:

## Economics 812 Midterm

## Prof. Bryan Caplan

## Spring, 2013

## Instructions:

- You have 100 minutes to complete this exam.
- Write directly on the exam!
- You may use any books, notes, or other materials that you wish, but avoid spending too much time on any one question.
- Partial credit may be awarded on all questions.
- The maximum possible number of points is 120 .
- You should have 5 pages, counting this one.


# Part 1: True, False, and Explain <br> (10 points each - 2 for the right answer, and 8 for the explanation) 

State whether each of the following six propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. True, False, and Explain: As population increases, finding real-world Pareto improvements becomes more difficult.
2. Suppose all agents have lexicographic preferences for either $X$ or $Y$. At least one agent has lexicographic preferences for $X$ over $Y$, and at least one agent has lexicographic preferences for Y over X . All agents start with $\mathrm{X}>0$ and $\mathrm{Y}>0$.

True, False, and Explain: A unique general equilibrium exists.
3. Consider the following variant on the Ultimatum Game:

|  |  | Player 2 |  |
| :---: | :---: | :---: | :---: |
|  |  | Accept | Reject |
|  | $t$ | (10-t), $t$ | 0, Z |

$Z=0$ if $t \geq 5$, but $Z=1$ if $t<5$.
True, False, and Explain: There are an infinite number of PSNE, but only one SGPNE.
4. "But once you're in the theater, the owner has a lot of monopolies." (Landsburg, The Armchair Economist)

True, False, and Explain: Landsburg's point is that when monopolies sell a product with multiple features, they tend to reduce quality on all margins to charge a monopoly price for each and every product feature.
5. Consider an infinitely repeated Bertrand game with N equally productively efficient firms with constant MC and 0 fixed cost. The firms want to collude. Their system: each period, the cartel randomly picks one firm (1/N chance per firm) to charge the monopoly price. All the other firms charge the monopoly price $+\$ 0.01$. The firms enforce this agreement with trigger strategies.

True, False, and Explain: Since all firms expect a $1 /$ Nth share of the monopoly, this equilibrium is sustainable as long as $\beta \geq \frac{N-1}{N}$.
6. True, False, and Explain: Kreps argues that in the "noisy" real world, trigger strategies are not a practical way to sustain collusion. Instead, colluding firms would only punish if prices were significantly below the agreed level.

## Part 2: Short Answer

## (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. Caplan $(1999,2001)$ defends the unrestricted use of subjective probability theory in economics. What is the best objection to his position? State your case as forcefully as possible.
2. Suppose artificial intelligence researchers produce and patent a perfect substitute for human labor at zero MC. Use general equilibrium theory to predict the overall economic effects on human welfare before AND after the Artificial Intelligence software patent expires.
3. Suppose you play a 5-turn Centipede Game with (a) a random American, and (b) a random Ph.D. Micro student at GMU. How would you personally play in each of these cases? What percentage of the theoretical maximum payoff would you receive in each case? Explain your answer.

## Name:

## Economics 812 Midterm <br> Prof. Bryan Caplan <br> Spring, 2014

## Instructions:

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- Write directly on the exam!
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- The maximum possible number of points is 120 .
- You should have 5 pages, counting this one.


## Part 1: True, False, and Explain

(10 points each - 2 for the right answer, and 8 for the explanation)
State whether each of the following six propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. Suppose the government imposes a tax on air pollution.

True, False, and Explain: While this tax doesn't have to be a Kaldor-Hicks improvement, it remains theoretically possible for it to be a Pareto improvement.
2. Suppose that two players play this PD game, followed by this Coordination game.

|  | Defect | Don't |
| :--- | :--- | :--- |
| Defect | 3,3 | 4,0 |
| Don't | 0,4 | 2,2 |


|  | $L$ | $R$ |
| :--- | :--- | :--- |
| $L$ | 5,5 | 0,0 |
| $R$ | 0,0 | 5,5 |

True, False, and Explain: If $B=.9$, the only SGPNE are (Defect, Defect), (L,L) and (Defect, Defect), (R, R).
3. True, False, and Explain: In an Ultimatum game, a $50 / 50$ split is the only SGPPSNE; in a Dictator game, a 100/0 split is the only SGPPSNE.
4. "Suppose that a manufacturer does hold an unbreakable patent on a particular product." (Kreps, A Course in Microeconomic Theory)

True, False, and Explain: Kreps says that firms may engage in entry deterrence even if they have a legal monopoly (such as a patent).
5. Suppose firms in an industry have the same cost function, including a sunk cost. Product demand falls, leading to a halving of potential monopoly profits. Two firms play mixed strategies to decide whether to enter.

True, False, and Explain: The probability that both firms enter and lose money falls by a factor of four.
6. Suppose N equally efficient firms lobby the government for a monopoly privilege. The firms never collude.

True, False, and Explain: Bertrand-style lobbying will lead to a larger Tullock rectangle than Cournot-style lobbying would.

## Part 2: Short Answer

## (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. Why doesn't the First Welfare Theorem imply that market outcomes are Pareto efficient even in the presence of externalities? Why does Caplan claim that, the First Welfare Theorem notwithstanding, real-world market outcomes are Pareto efficient in the presence of externalities?
2. Suppose you had to play a 100 -turn Hawk/Dove game with one other student in this class. Before the game starts, you are allowed to send your partner a one-paragraph essay on the theme, "You should cooperate with me because..." What would your essay say if you wanted to maximize your payoff? Be as persuasive as possible.
3. Landsburg ("Why Prices Are Good: Smith versus Darwin") states that, "In biology there is no equivalent of the Invisible Hand." Would Landsburg expect there to be an Invisible Hand for culture? Explain what you think Landsburg would say, then argue that he's wrong. (Hint: Remember that cultural practices are often coordination games).

## Name:

## Economics 812 Midterm

Prof. Bryan Caplan
Spring, 2015

## Instructions:

- You have 100 minutes to complete this exam.
- Write directly on the exam!
- You may use any books, notes, or other materials that you wish, but avoid spending too much time on any one question.
- Partial credit may be awarded on all questions.
- The maximum possible number of points is 120 .
- You should have 5 pages, counting this one.


## Part 1: True, False, and Explain

(10 points each - 2 for the right answer, and 8 for the explanation)
State whether each of the following six propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. True, False, and Explain: In the real world, taxes on goods with negative externalities are always the least inefficient way for governments to raise a given amount of revenue.

## Problems 2 and 3 refer to the following information.

Agents live for two periods. They are endowed with 1 unit of a consumption good in period 1 and 1 unit in period 2 . The period 1 good spoils if not consumed in period 1 . There are two types of agents:

Type A: $50 \%$ of the agents have $\mathrm{U}=\mathrm{In} \mathrm{c} 2$.
Type B: The other $50 \%$ have $U=\ln \mathrm{C}_{1}+\ln \mathrm{C}_{2}$
2. True, False, and Explain: The general equilibrium interest rate will be less than 3\%.
3. True, False, and Explain: If the two types of agents do not interact (i.e., there is one island for all of the A's and a different island for all of the B's), the interest rate will be negative for A's but zero for B's.
4. "In biology, there is no equivalent of the Invisible Hand." (Landsburg, The Armchair Economist)

True, False, and Explain: Landsburg's discussion implies that in game theory, there is an equivalent of the Invisible Hand.
5. Suppose two players play the following normal form $N$ times. $N$ is finite and known by both players.

|  | Left | Right |
| :--- | :--- | :--- |
| Left | 5,1 | 0,0 |
| Right | 0,0 | 1,5 |

True, False, and Explain: Alternating back and forth between (L,L) and (R,R) is a SGPPSNE equilibrium for all $\boldsymbol{N}$ and all $\boldsymbol{\beta}>0$.
6. Suppose Cournot firms have TC=2 (i.e., fixed cost of 2 with $\mathrm{MC}=0$ ). The demand curve is $P=10-Q$.

True, False, and Explain: With free entry, the equilibrium number of firms is 5 , with a deadweight cost of 8.

## Part 2: Short Answer

## (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. "Mises is correct to point out that beliefs about the efficacy of action are implicit in action. But he at best misspeaks when he characterizes this necessary feature of action as knowledge of 'causality.' Instead, the necessary belief component of action is weaker; we don't need to knowor even believe we know-any exceptionless causal laws. We merely require beliefs about conditional probabilities." (Caplan, "Probability, Common Sense, and Realism")

Use Caplan's analysis of the connection between beliefs and actions to explain why you showed up for this evening's exam.
2. "Schelling points explain why countries rarely fight wars, but fail to explain why countries often fight wars over seemingly minor events." Discuss, providing at least two real-world examples.
3. Suppose a society is in a very low-trust equilibrium: People don't trust others because others aren't trustworthy, and no one bothers to be trustworthy because no one will trust them. If you personally wanted to break out of this low-trust equilibrium - to become a widely trusted "honest broker" - what would you do? Carefully describe your strategy, step-by-step.

## Name:

## Economics 812 Midterm

Prof. Bryan Caplan
Spring, 2016

## Instructions:

- You have 100 minutes to complete this exam.
- Write directly on the exam!
- You may use any books, notes, or other materials that you wish, but avoid spending too much time on any one question.
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- The maximum possible number of points is 120 .
- You should have 5 pages, counting this one.


# Part 1: True, False, and Explain <br> (10 points each - 2 for the right answer, and 8 for the explanation) 

State whether each of the following six propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. Suppose all the assumptions of the First Welfare Theorem are true.

True, False, and Explain: Markets are Pareto and Kaldor-Hicks efficient.
2. Suppose $45 \%$ of all agents in an economy have $U=\ln x+\ln y$, and the other $55 \%$ have $U=.75 \ln x+.25 \ln y$. All agents start with one unit of $x$ and two units of $y$.

True, False, and Explain: In general equilibrium, exactly 55\% of the agents consume more $y$ than $x$.
3. Suppose that two players play the following three games in order: Coordination game, Prisoners' Dilemma, Ultimatum game.

True, False, and Explain: Standard game theory predicts that this game will completely "unravel."
4. "But once you're in the theater, the owner has a lot of monopolies. He is the only supplier of rest rooms, for example. Why doesn't he charge you a monopoly price to use them? (Landsburg, The Armchair Economist)

True, False, and Explain: Landsburg concludes that customer diversity, not supplier monopoly, explains why popcorn costs more at movies.
5. Suppose two players play the following normal form $N$ times. $N$ is finite and known by both players.

|  | Left | Right |
| :--- | :--- | :--- |
| Left | 5,1 | 0,0 |
| Right | 0,0 | 1,5 |

True, False, and Explain: Alternating back and forth between (L,L) and (R,R) is an equilibrium as long as $N$ is even and $\beta<1$.
6. Consider a Cournot model with two firms. $P=20-Q$, and $M C=0$.

True, False, and Explain: If one firm moves first, the unique SGPNE has a higher $Q$ than it does with simultaneous play.

## Part 2: Short Answer <br> (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. Construct a "second-best" efficiency defense of ONE existing policy you consider highly inefficient in a "first-best" sense. Be as convincing as possible.
2. "[l]t seems that the basic textbook commentary on bilateral monopoly and bargaining had it right." (Kreps, A Course in Microeconomic Theory) Carefully explain (a) what Kreps is claiming here, and (b) why he claims it. Does a MSNE view of bargaining lead to a different conclusion?
3. What is the most empirically relevant model our class has studied so far? The least empirically relevant model? Justify both answers.

Name: $\qquad$

## Economics 812 Midterm <br> Prof. Bryan Caplan <br> Spring, 2017

## Instructions:

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- Write directly on the exam!
- You may use any books, notes, or other materials that you wish, but avoid spending too much time on any one question.
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- The maximum possible number of points is 120 .
- You should have 5 pages, counting this one.


## Part 1: True, False, and Explain <br> (10 points each - 2 for the right answer, and 8 for the explanation)

State whether each of the following six propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. Suppose a million new immigrants enter the U.S., driving down the wages of low-skilled Americans by $\$ 1 /$ hour.

True, False, and Explain: According to Landsburg (Fair Play), this change usually increases Kaldor-Hicks efficiency, because the positive externalities of population growth hugely outweigh the negative externality of falling wages for natives.
2. Two types of agents consume guns (g) and butter (b). The Type A agents have $U=.7 \ln g+.3 \ln b$, and initially own 1 unit of guns and 1 unit of butter. The Type B agents have $\mathrm{U}=.3 \mathrm{ln} \mathrm{g}+.7 \mathrm{In} \mathrm{b}$, and initially own .5 units of guns and .5 units of butter. $50 \%$ of the agents are Type A; the other $50 \%$ are Type B.

True, False, and Explain: In GE, the price of guns will not equal the price of butter.
3. Consider the following 2-player game:

|  | Up | Down |
| :--- | :--- | :--- |
| Left | 0,0 | 0,0 |
| Right | 0,0 | 0,0 |

True, False, and Explain: This game has 4 PSNE but no MSNE.
4. Suppose two players play the following normal form $N$ times. $N$ is finite and known by both players.

|  | Left | Right |
| :--- | :--- | :--- |
| Left | 5,0 | 0,0 |
| Right | 0,0 | 0,5 |

True, False, and Explain: Alternating back and forth between (L,L) and (R,R) is always an equilibrium as long as $N$ is even.
5. Suppose each firm in an industry has $\mathrm{TC}=q_{i}^{2}$; i.e., zero fixed costs with increasing marginal costs. Industry demand is given by $\mathrm{P}=1 / \mathrm{Q}$, where $\mathrm{Q}=\sum_{\forall i} q_{i}$.
True, False, and Explain: Bertrand competition will allow an infinite number of firms to survive in this market, implying no productive or allocative inefficiency.
6. True, False, and Explain: The War/Peace game confirms the view that the invention of atomic weapons reduced the risks of war and human extinction.

## Part 2: Short Answer <br> (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. People (including economists) often think that monopolies are productively inefficient. Why, on reflection, would this be strange? What additional assumptions do you need to make the "inefficient monopolies" story internally consistent?
2. Suppose artificial intelligence researchers competitively produce a zero MC perfect substitute for ALL human labor (but not other inputs). Use general equilibrium theory to predict the effects on output, wages, profit, and overall human welfare.
3. Use an insight from Kreps we did NOT discuss in class to analyze something economically interesting in the real world. Clearly explain how a specific statement from Kreps helps explain specific individual or firm behavior.

## Name:

## Economics 812 Midterm

Prof. Bryan Caplan
Spring, 2018

## Instructions:

- You have 100 minutes to complete this exam.
- Write directly on the exam!
- You may use any books, notes, or other materials that you wish, but avoid spending too much time on any one question.
- Partial credit may be awarded on all questions.
- The maximum possible number of points is 120 .
- You should have 5 pages, counting this one.

Part 1: True, False, and Explain
(10 points each - 2 for the right answer, and 8 for the explanation)
State whether each of the following six propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. "Dice are always rolled at a particular time and place, in casinos of varying honesty, so we never 'know nothing but that they are elements' of the class of dice. Additional information inevitably accompanies every real case." (Caplan, "The Austrian Search for Realistic Foundations")

True, False, and Explain: Caplan is trying to convince Austrian economists to accept subjective probability theory, but they could consistently conclude that objective probability theory never applies in the real world.
2. True, False, and Explain: A general equilibrium can exist if ONE person's utility function is linear, but cannot exist if EVERYONE's linear utility function is linear.
3. True, False, and Explain: Ultimatum games have a unique Nash equilibrium.
4. Suppose two players infinitely repeat the following normal form.

|  | Left | Right |
| :--- | :--- | :--- |
| Left | 5,5 | 2,6 |
| Right | 6,2 | 0,0 |

True, False, and Explain: If $\beta=\mathbf{1}$, there is a trigger strategy where players play (Left, Left) forever.
5. Suppose an industry with $\mathrm{TC}=100+5^{*} \mathrm{Q}$ is run by a contestable monopoly. There are four other potential producers, each with the same TC function.

True, False, and Explain: If antitrust authorities limit every producer to onefifth of the market, this will have no effect on allocative efficiency, reduce productive efficiency, and hurt consumers.
6. Suppose Bertrand producers create a cartel that lets every firm in the industry produce $1 / \mathrm{N}$ of the monopoly level of output, where N is the total number of firms.

True, False, and Explain: Every individual firm will want to split, which will ultimately destroy the cartel unless the discount factor is $\mathbf{1}$ for all firms.

## Part 2: Short Answer

## (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. Suppose a negative externality exists in a market. Describe two situations: one where laissez-faire is first-best efficient, and another where laissez-faire is second-best efficient. Be specific!
2. Tullock ran a variant on the repeated Prisoners' Dilemma where participants were allowed to fire their partners. The result was unusually high cooperation. How would you revise this experiment to highlight situations where reputational incentives lead to unusually low cooperation? Carefully describe your experimental design.
3. Many historians argue that, in the long-run, well-run nations absorb poorly-run nations. Building on Landsburg's ("Why Prices Are Good: Smith versus Darwin") under what conditions should expect this process to be Kaldor-Hicks efficient? Carefully explain your answer - and provide a relevant historical example.

Name: $\qquad$

## Economics 812 Midterm <br> Prof. Bryan Caplan <br> Spring, 2019

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## Part 1: True, False, and Explain <br> (10 points each - 2 for the right answer, and 8 for the explanation)

State whether each of the following six propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. Suppose a firm produces $\$ 10 \mathrm{M}$ worth of sweatshirts a year. Labor, the only input, initially costs \$6M. After the workers unionize, however, they manage to double their pay without reducing hours of employment.

True, False, and Explain: Shutting down the firm in response to unionization would be a Kaldor-Hicks improvement.
2. Suppose two players play the following normal form:

|  | English | Hebrew |
| :--- | :--- | :--- |
| English | 10,2 | 0,0 |
| Hebrew | 0,0 | 1,5 |

True, False, and Explain: There are two PSNE, but no MSNE exists.
3. Over the last 40 years, standard tipping in American restaurants has risen from $10 \%$ to $18 \%$.

True, False, and Explain: Landsburg ("The Indifference Principle" in The Armchair Economist) would predict zero effect on waiters' take-home pay.
4. 12 firms play an infinitely repeated Cournot game. Industry demand is given by $P=10-Q / 2$. There are zero production costs.

True, False, and Explain: If firm i defects, it spends one turn maximizing the following function wrt qi: (10-.5[qi + 110/12]) $q_{i}$.
5. True, False, and Explain: In Fair Play, Landsburg's chapter "People Wanted," seems to predict accelerating economic growth over the last century.
6. Suppose that two firms flip a coin, then play a contestable monopoly game with sunk costs.

True, False, and Explain: The coin flip allows the firms to raise their expected profits, even though the set of equilibria in the contestable monopoly game does not change.

## Part 2: Short Answer <br> (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. "In the real world, electronic road pricing is Kaldor-Hicks superior to toll-free roads." Do you agree or disagree? Thoughtfully explain your reasoning.
2. Carefully explain why lexicographic preferences could prevent the existence of general equilibrium. Illustrate your explanation with a numerical example.
3. Some tech firms - including Google, Facebook, and Twitter - have supplied their services to customers free of charge for many years. Are they engaged in "predation" in any of the game theoretic senses discussed in class? Why or why not? Explain your answer.

Name: $\qquad$

## Economics 812 Midterm (Version A) <br> Prof. Bryan Caplan <br> Spring, 2019

## Instructions:

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- Partial credit may be awarded on all questions.
- The maximum possible number of points is 120.
- You should have 5 pages, counting this one.


## Part 1: True, False, and Explain

(10 points each - 2 for the right answer, and 8 for the explanation)
State whether each of the following six propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. True, False, and Explain: Kaldor-Hicks efficiency puts extra weight on the well-being of the rich, but Pareto efficiency and utilitarianism do not.

Suppose you play the following Hawk/Dove game sequentially, rather than simultaneously, so Player 1 picks his strategy, Player 2 sees Player 1's choice, then Player 2 picks his strategy.

|  |  | Player 2 |  |
| :--- | :--- | :--- | :--- |
| $\stackrel{\rightharpoonup}{\stackrel{\omega}{\omega}}$ |  | War | Peace |
|  | War | $-50,-50$ | 5,1 |
|  | Peace | 1,5 | 4,4 |

2. True, False, and Explain: In a one-shot game, (War, War) never happens, and Player 1 always has a higher payoff than Player 2.
3. True, False, and Explain: FINITE repeated play allows (Peace, Peace) to be a PSNE, even if the same person always gets to be Player 1.
4. True, False, and Explain: The main point of Ultimatum Game experiments is to show that people don't play subgame perfect PSNE even in extremely straightforward situations.
5. Suppose a Bertrand industry has two firms. The first has $\mathrm{TC}=100 \mathrm{q}_{1}$. The second has TC=100+q2.

True, False, and Explain: Firm 1 will take over the entire market, and charge a price equal to its own Average Cost of 100.
6. Social Security costs the U.S. about a trillion dollars per year, but total lobbying on this program (indeed, all programs combined) is vastly less than one trillion dollars. Hence, we see nothing close to "full rent dissipation."

True, False, and Explain: One possible explanation is that lobbying to modify such a broad-based program has massive externalities.

## Part 2: Short Answer

## (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. "In the real world, the Second Welfare Theorem is barely relevant unless you can also redistribute human capital." Why exactly would someone think this? Would they be correct to do so? Who cares? Carefully explain your reasoning.
2. How would you improve upon Landsburg's efficiency analysis in Fair Play, Chapter 13: People Wanted?
3. In lecture, Caplan has mentioned numerous potentially fruitful avenues for research. Name the avenue that you consider most promising. What exactly makes it relatively promising? How would you explore it in a research paper? Sell your idea!

Name: $\qquad$

## Economics 812 Midterm (Version B) <br> Prof. Bryan Caplan <br> Spring, 2019

## Instructions:

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- The maximum possible number of points is 120.
- You should have 5 pages, counting this one.


# Part 1: True, False, and Explain <br> (10 points each - 2 for the right answer, and 8 for the explanation) 

State whether each of the following six propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. "An inefficient decision a/ways entails a missed opportunity to make everyone happier." (Landsburg, Armchair Economist)

True, False, and Explain: This contradicts the Week 1 notes.
2. Suppose the price of gasoline rises, which raises the cost of oil extraction, which reduces demand for oil workers. As a result, oil workers reduce their demand for gasoline, which reduces its price.

True, False, and Explain: Economic theorists can handle all this complexity WITHOUT using game theory.
3. Consider this bargaining game, and suppose it is played sequentially: Player 1 picks his strategy, Player 2 sees Player 1's choice, then Player 2 picks his strategy.

|  |  | Player 2 |  |
| :---: | :---: | :---: | :---: |
|  |  | Hard | Soft |
|  | Hard | 0,0 | 5,1 |
|  | Soft | 1,5 | 4,4 |

True, False, and Explain: There is still a MSNE.
4. True, False, and Explain: Caplan ("Probability, Common-Sense, and Realism") denies that neoclassical economists have neglected the dependence of their results on the mathematical assumption of continuity.
5. Suppose four Cournot firms try to use trigger strategies to hold the market price at the monopoly level. The $\beta$ 's for these firms are as follows: .6, .7, .8, and . 9.

True, False, and Explain: Collusion will not work unless the firm with $\beta=.6$ exits the market.
6. Consider the voluntary donation and Cournot oligopoly games.

True, False, and Explain: As long as both games have the same number of players, getting total donations above zero in the voluntary donation game is just as hard as getting effective collusion in the Cournot game.

## Part 2: Short Answer

## (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. A year ago, how could you have used Arrow-Debreu contingent claims markets to improve COVID policy?
2. "In the real world, perfect competition, oligopoly, and monopoly are all secondbest efficient whenever they emerge as a result of unregulated competition." To what extent do you agree? Defend your position, using both theory and empirical evidence.
3. Compare and contrast the "classic" reasons to doubt the efficacy of predation to game-theoretic reasons to doubt its efficacy. Which set of reasons is more compelling in the real world?

## Name:

## Economics 812 Midterm

Prof. Bryan Caplan
Spring, 2022

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## Part 1: True, False, and Explain <br> (10 points each - 2 for the right answer, and 8 for the explanation)

State whether each of the following six propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. True, False, and Explain: According to Landsburg ("Why Taxes Are Bad"), taxes are Kaldor-Hicks inefficient because they reduce production of goods and services.
2. Suppose that no one in an economy has a utility function (e.g. due to lexicographic preferences).

True, False, and Explain: A general equilibrium will definitely not exist.
3. Suppose that two players play this PD game, followed by this unusual Coordination game.

|  | Defect | Don't |
| :--- | :--- | :--- |
| Defect | 3,3 | 4,0 |
| Don't | 0,4 | 2,2 |


|  | L | R |
| :--- | :--- | :--- |
| L | 5,1 | 0,0 |
| $R$ | 0,0 | 1,5 |

True, False, and Explain: If $B=1$, neither (Don't, Don't), (L, L) nor (Don't, Don't), (R, R) are PSNE.
4. True, False, and Explain: With free entry, productive inefficiency is impossible in both the Bertrand and Cournot models.
5. Suppose the government gives one car manufacturer a monopoly privilege. The lobbying process leads to full rent dissipation. Each firm has the same constant marginal cost of production, and demand is linear.

True, False, and Explain: Deadweight costs fall when demand falls or firms' costs rise.
6. Landsburg ("People Wanted") argues that the typical human being has large positive externalities.

True, False, and Explain: This does NOT imply that maximizing human population is Kaldor-Hicks efficient.

## Part 2: Short Answer

## (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. Common-sense says that even if you did a one-time full equalization of wealth, inequality would quickly re-emerge. The Second Welfare Theorem appears to say the opposite. Is common sense wrong? Is the Second Welfare Theorem being misinterpreted? Or what? Carefully explain your answer.
2. Suppose the whole human race perishes except for you and a randomly selected human being. The two of you meet up. Will you reach a Pareto efficient outcome? Fight until one kills the other? Or what? Carefully explain the game theory you're using to justify your answer.
3. Why doesn't Amazon charge much higher prices? Craft a compelling answer using everything relevant that you've learned.

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## Economics 812 Midterm

## Prof. Bryan Caplan

## Spring, 2023

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# Part 1: True, False, and Explain <br> (10 points each - 2 for the right answer, and 8 for the explanation) 

State whether each of the following six propositions is true or false. Using 2-3 sentences AND/OR equations, explain your answer.

1. Suppose the government replaces a firm-by-firm air pollution quota with a tax that keeps total air pollution constant.

True, False, and Explain: This tax will almost certainly be a Kaldor-Hicks improvement, but almost certainty not be a Pareto improvement.
2. Suppose everyone has linear utility functions, such as $U=a X+b Y+c Z$, where $X, Y$, and $Z$ are goods and $a, b$, and $c$ are preference parameters.

True, False, and Explain: A general equilibrium may exist as long as everyone doesn't have the same values of $a, b$, and $c$.
3. Suppose a pirate robs two people and puts all of their money inside a treasure chest. When the police recover the chest (and before the pirate can spend a penny), they ask each of the victims to state how much money he lost. To discourage lying, the police announce that if the total losses claimed by the victims exceeds the total amount of money in the chest, none of the victims will get any money back.

True, False, and Explain: If play is sequential, there are an infinite number of PSNE, but only one SGPPSNE, wherein both victims honestly report their losses.
4. Suppose you have the following infinitely repeated Hawk/Dove game.

|  |  | Player 2 |  |
| :---: | :---: | :---: | :---: |
|  |  | Hawk | Dove |
|  | Hawk | -100,-100 | 5,1 |
|  | Dove | 1,5 | 4,4 |

True, False, and Explain: Full cooperation is sustainable with trigger strategies as long as $\beta \geq .25$ for both players.
5. True, False, and Explain: Given the technical definitions of "finitelyrepeated game" and "infinitely-repeated game," the problem of the PD and Centipede games inevitably "unraveling" is just a theoretical curiosity.
6. Suppose $N$ equally efficient firms lobby the government for a monopoly privilege. The firms never collude.

True, False, and Explain: Firms will spend more resources lobbying under Bertrand competition than under Cournot competition.

## Part 2: Short Answer

## (20 points each)

In 4-6 sentences AND/OR equations, answer all three of the following questions.

1. Kreps spends a lot of pages discussing Pareto efficiency. How would Kreps react to Caplan's claim that everything in the real world is Pareto efficient? What would be the most intellectually satisfying way for Kreps to justify all of the attention he pays to Pareto efficiency?
2. "One of the great lessons of economics is that there is no single best way to resolve such choices; everything depends on circumstances; what's right for you can be wrong for your neighbor. Economics is the science of tolerance." (Landsburg, Fair Play)

Name TWO game theoretic ideas that we've discussed in class that are hard to reconcile with Landsburg's claim. How would Landsburg reply? Who's right?
3. How severe are intra-familial externalities in the real world? Discuss the efficacy of Coasean bargaining, reputation, and altruism as remedies. Do any of these remedies work well? Do any actually make the intra-familial externality problem worse?

