

14.03/14.003 Exam 2

Fall 2014

Professor David Autor

Wednesday, 11/12/2014

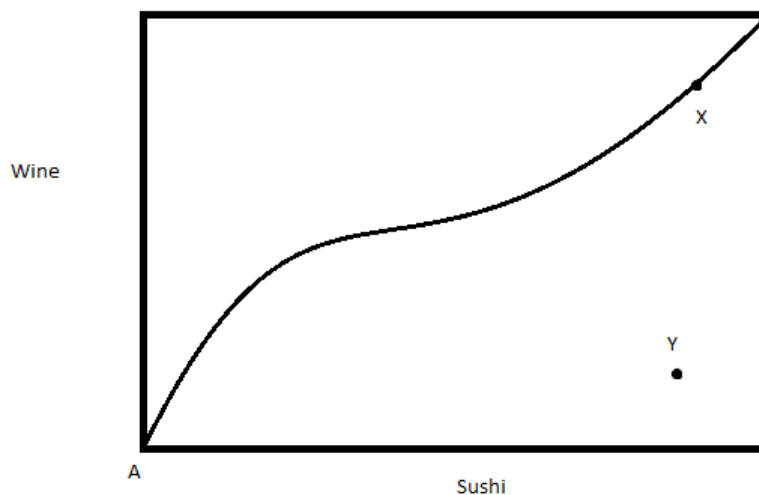
Instructions

- Please do not open this exam until directed
- There are 80 points on this exam and you have 80 minutes to complete it.
- You may not use a calculator (there is no need for it).
- No other reference material is allowed.
- There are 3 parts to the exam: please use a separate exam book for each part.
- Correct answers without explanation do not receive credit.
- Part I is SHORT ANSWER. Answer 4 problems of 6. (5 points each, 20 points total.) You must explain your answers with one or two sentences or graphs. Correct answers without explanation do not receive credit. *If you answer more than 4 questions, we will only grade the first 4.*
- Part II has 1 long question that you must answer. (30 points)
- Part III has 1 long question that you must answer. (30 points)

Part I

Short Questions: Answer 4 of 6 questions [5 points each, 20 points total]

1. **[Trade-Feyrer]** Feyrer (2009) uses an instrumental variables (IV) strategy to estimate the causal effect of trade on income. The fact that not *only* goods are transported by airplane but *also* people (for example, diplomats, CEOs, and tourists) is a potential problem for his IV strategy. *True, False or Uncertain and why?*
2. **[Coase theorem]** The First Welfare Theorem says that under certain conditions, a free market in equilibrium will reach a Pareto efficient outcome. Does the Coase Theorem *increase, decrease* or *leave unchanged* the number of necessary conditions required for the First Welfare Theorem to apply? *Explain.*
3. **[Gains from trade]** The figure below depicts an Edgeworth Box exchange economy with two consumers, two commodities (Sushi and Wine), and one contract curve as drawn. Under autarky, the two consumers will trade with each other from any initial endowment point until they reach a competitive equilibrium on the contract curve. *True, False or Uncertain and why:*
 - (a) If the initial endowment is at point X , introducing international trade at some fixed price ratio p will make both consumers weakly better off;
 - (b) if the initial endowment is at point Y , introducing international trade at some fixed price ratio p will make both consumers weakly better off.



4. **[Partial equilibrium]** A fully competitive labor market (with no monopsony and no minimum wage) is in equilibrium at hourly wage W^* and employment level L^* . The government

grants employers a tax subsidy of \$2 per worker per hour. *True, false, uncertain and why:* The equilibrium wage W^* will rise by no more than \$1 per hour.

5. [**Jensen-fishermen**] In the Indian state of Kerala prior to the introduction of cell phones, the fish market was clearly Pareto inefficient. On any given day, fish were thrown away on some beaches while on other beaches, no fish were available despite many buyers. *What was the primary source of the market failure? Explain.*
6. [**Externalities**] On hot days in Los Angeles, most businesses run their air conditioning at maximum capacity. This creates a congestion externality that can overload the electrical grid, leading to a brownout or power failure. *True, false, uncertain and why:* An efficient way for a regulator to correct this externality is to restrict the energy provided to each business to Q/N kilowatt hours, where Q is the total kilowatt hours of power generation available and N is the number of businesses.

Part II

The Pokémon Principle [30 points]

Holly and Ash are Pokémon trainers. Holly has an endowment of 10 water-type pokémon w and 0 fire-type pokémon f . Ash has an endowment of 10 fire-type pokémon f and 0 water-type pokémon w . We write their initial endowments as $E(w, f)$:

$$E_H = (10, 0), E_A = (0, 10).$$

Holly and Ash have identical utility functions:

$$\begin{aligned} U_H(w_H, f_H) &= w_H f_H + w_H + f_H, \\ U_A(w_A, f_A) &= w_A f_A + w_A + f_A. \end{aligned}$$

You can ignore discreteness throughout this question.

1. Holly and Ash decide to trade with each other. Show that trade is Pareto-improving over autarky. You can take a short-cut by using the fact that the market-clearing relative price of fire-type f and water-type w pokémon is equal to one (which comes from the symmetry of their utility functions and endowments). Be sure to solve for Holly's and Ash's demands for w and f in terms of the prices p_w and p_f . You will also need these demand functions below. *Please use the normalization $p_f = 1$.* **(9 points)**
2. Assume Holly and Ash are back at their initial endowments. Holly tells Ash that she wants to see the world, so they leave their home town in upstate New York and travel to Kyrgyzstan. Now they can trade with market vendors there, and there is an unlimited supply of w and f pokémon available at market prices. It is well known that fire-type pokémon are common in Kyrgyzstan, and as a result the relative price of water-type pokémon is high, i.e. $\frac{p_w}{p_f} = p_w = 5$ (normalizing $p_f = 1$). Assume that Holly and Ash's endowments are small enough that they cannot affect this relative price. Show that this 'international trade' is not Pareto-improving. **(6 points)**
3. Explain why one party is strictly worse off under trade. **(4 points)**
4. What could be done to make the outcome of trade with Kyrgyzstan a Pareto improvement over just trade with each other? Show this result graphically. What theorem are we invoking? **(8 points)**
5. Given that trading with Kyrgyzstan did not affect either Ash's or Holly's endowment, explain *why* trading with Kyrgyzstan leads to a potential Pareto improvement (after transfers). *[Hint: Could we have achieved a Pareto improvement simply by setting $p_w = 5$ without trading with Kyrgyzstan?]* **(3 points)**

Part III

Causal Inference with Instrumental Variables (30 points)

In the slums of India, poor patients often seek medical help from Bengali doctors. Bengali doctors are untrained and largely unqualified primary healthcare providers. The government wants to train Bengali doctors to identify life-threatening conditions such as heart disease so that they can refer patients to hospitals when needed.

Among a group of 1,000 Bengali doctors, the government randomly invites 500 to participate in medical training. You wish to measure the causal effect of government-provided training to Bengali doctors on their patients' survival. For each doctor, you identify one patient who suffered from heart disease *prior to* the study. You define the following variables

$$\begin{aligned} Z_i &= \begin{cases} 1 & \text{if doctor } i \text{ was invited to the training} \\ 0 & \text{if doctor } i \text{ was not invited to the training} \end{cases} \\ D_i &= \begin{cases} 1 & \text{if doctor } i \text{ came to the training} \\ 0 & \text{if doctor } i \text{ did not come to the training} \end{cases} \\ Y_i &= \begin{cases} 1 & \text{if patient } i \text{ survives for one year after the program} \\ 0 & \text{if patient } i \text{ does not} \end{cases} \end{aligned}$$

Note that i refers to both *doctor and patient* since you have only one patient per doctor. (This is meant to *simplify* notation, not to confuse you.)

1. **[3 points]** Using the notation developed throughout the class, write down the causal effect that you are interested in. Explain your notation carefully. Call this estimate T^* .
2. **[4 points]** A government official proposes estimating the effect of the training program on patient health by contrasting the outcomes of patients whose doctors attended the training with the outcomes of patients whose doctors did not attend the training:

$$T_1 = E[Y_i | D_i = 1] - E[Y_i | D_i = 0]$$

Would you expect T_1 to be an unbiased estimate of T^* ? Explain.

You decide to apply an instrumental variable (IV) strategy to estimate T^* . You use the random assignment of the invitation to training Z_i as an instrument for attending training D_i .

3. **[6 points]** State formally *and explain* the conditions necessary for the invitation Z_i to be a valid instrument for training D_i . Are these assumptions likely to be met in this setting?

4. **[5 points]** Write down the equation for the instrumental variables estimate. Call this T_{IV} . Of what *two* casual effects is T_{IV} the ratio?
5. **[6 points]** You discover that at a recent meeting of the Bengali Doctors' Association, doctors from the treatment group gave medical training to some of the doctors in the control group. Will the IV estimate in part (4) produce an unbiased estimate of T^* ? Explain why or why not.
6. **[6 points]** Assume that the Bengali Doctors Association meeting in part (5) did *not* occur. Analyzing your data, you discover that some doctors from the control group *also* attended the training: $E[D_i|Z_i = 0] > 0$. However, a much larger fraction of treatment than control group doctors attended the training: $E[D_i|Z_i = 1] > E[D_i|Z_i = 0]$. Will the IV estimate in part (4) produce an unbiased estimate of T^* ? Explain why or why not. Note that you observe D_i for all doctors, so you can calculate $E[D_i|Z_i = 1]$ and $E[D_i|Z_i = 0]$. [*This is a challenging question. Save it for last as time permits.*]

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Fall 2025

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