

Please write all answers in legible handwriting in the space provided. Points will be deducted if the grader cannot read what you wrote. For math questions, show all relevant work. **For questions with numeric answers, clearly circle or box your final answer.** For the first 4 questions, circle **one** option from the multiple choice.

**Total points possible: 25**

1. (1 point) By Edward Glaeser's reckoning (as expressed in chapter 3 of *Triumph of the City*) to whom should we compare the urban poor living in the favelas of Rio de Janeiro?
  - (A) to the urban poor of Lisbon, capital of Portugal, Brazil's former colonial ruler
  - ☒ (B) to the rural poor living in northeastern Brazil
  - (C) to the urban poor in other South American metropolises, such as Buenos Aires, Santiago, or Lima
  - (D) to the poor in the ghettos of U.S. cities (such as Los Angeles)
2. (1 point) Which of these ideas does Glaeser recommend to alleviate urban poverty?
  - (A) invest in agricultural improvements so that agricultural workers will be more productive and less inclined to move to cities
  - (B) pay rural residents to continue living in rural areas, and allow them to spend the extra money however they wish
  - (C) improve rural infrastructure (transport, communications, and utilities) so that many of the urban poor will return to rural areas and not further stress the already strained urban infrastructure
  - ☒ (D) improve urban infrastructure (roads, transport, and utilities) so that more people can benefit from the advantages of living in a city
3. (1 point) What is the precise meaning of the term "self-protecting urban innovation"?
  - (A) A cities ability to protect itself from disease
  - ☒ (B) A cities ability to generate the information needed to solve their own problems
  - (C) A description of the scale and scope of the ideas generated by cities
  - (D) None of the above
4. (1 point) As described in Chapter 5, why are people willing to accept lower real wages in certain cities? For example, why doesn't everyone from Honolulu move to Dallas?
  - (A) People usually live where they are born and do not care much about their wage
  - (B) Lower real wages are usually made up for with nicer weather
  - ☒ (C) Lower real wage cities generally have higher overall amenity values; parks, schools, weather, etc all might be better
  - (D) None of the above

## 1 Short answer

5. (5 points) Recall the locational indifference condition in the model of housing prices with commuting costs:

$$\Delta P \cdot h(x) + \Delta x \cdot t = 0$$

- (a) (1 point) If  $h(x) = 750$ , have we modeled consumers as being able to substitute? How do you know?

Since  $h(x)$  does not depend on  $x$ , no substitution is possible.

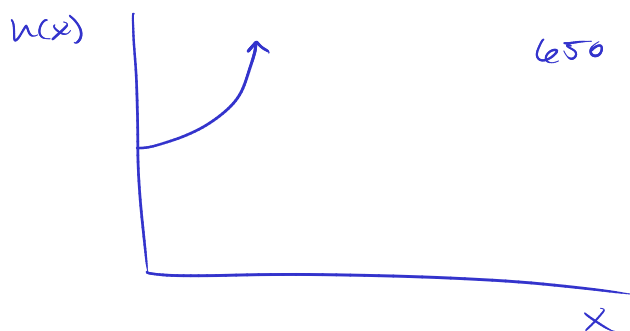
- (b) (1 point) Derive the slope of the bid-rent curve when  $h(x) = 750$

$$\begin{aligned}\Delta P \cdot h(x) + \Delta x \cdot t &= 0 \\ \Delta P \cdot h(x) &= -\Delta x \cdot t \\ \frac{\Delta P}{\Delta x} &= \frac{-t}{h(x)}\end{aligned}$$

$$\text{Slope} \Rightarrow \frac{\Delta P}{\Delta x} = \frac{-t}{750}$$

If they just wrote this give full credit.

- (c) (1 point) Now suppose  $h(x) = 650 + x^2$  for  $x \geq 0$ . Graph this equation and provide an interpretation for  $h(0) = 650$  (hint: think about what  $x$  represents).



Individuals will consume 650 sqft of housing at the city center

- (d) (1 point) Derive the slope of the bid-rent curve using  $h(x) = 650 + x^2$

$$\frac{\Delta P}{\Delta x} = \frac{-t}{650 + x^2}$$

- (e) (1 point) Find the distance  $x$  at which the two bid rent curves from part B and D have equal slope. (hint: set  $h(\cdot)$  from part B equal to part D and solve).

$$\frac{\Delta P}{\Delta x} = \frac{-t}{750} = \frac{-t}{650 + x^2}$$

$$650 + x^2 = 750$$

$$x^2 = 100$$

$$x = \pm 10 \rightarrow \boxed{x = 10}$$

6. (9 points) **A multi-sector model** Consider a version of the manufacturing bid-rent curve, but with two sectors. Let  $x_1$  and  $x_2$  be the distance that firms in sector 1 and sector 2 locate away from the city center. Firms face freight, labor, land costs, and a fixed intermediate goods cost ( $\bar{I} = 5$ ). To simplify the algebra, let's also assume that firms in each sector use only one unit of land (and thus the land cost,  $LC(x_i) = P(x_i)$  for  $i = 1, 2$ ). The labor costs for each firm (as a function of distance to center) is given by:

$$L(x_1) = 25 - A_1 * x_1$$

$$L(x_2) = 35 - A_2 * x_2$$

The freight costs for each firm as a function of distance is given by

$$F(x_1) = (B_1 + 3) * x_1$$

$$F(x_2) = (B_2 + 3) * x_2$$

- (a) (1 point) Write out the profit function for a firm in each sector. You should provide two equations. Do not assume that revenue is equal in each sector.

$$\pi_1 = TR_1 - [25 - A_1 x_1 + (B_1 + 3) x_1 + P(x_1) - 5]$$

$$\pi_2 = TR_2 - [35 - A_2 x_2 + (B_2 + 3) x_2 + P(x_2) - 5]$$

- (b) (2 points) Use your answer from part A to derive the bid-rent curves for manufacturing firms in each sector.

$$\pi_1 = \pi_2 = 0$$

$$(i) \quad 0 = TR_1 - 30 + (A_1 - B_1 - 3) x_1 - P(x_1)$$

$$\boxed{P(x_1) = TR_1 - 30 + (A_1 - B_1 - 3) x_1}$$

$$(ii) \quad 0 = TR_2 - 40 + (A_2 - B_2 - 3) x_2 - P(x_2)$$

$$\boxed{P(x_2) = TR_2 - 40 + (A_2 - B_2 - 3) x_2}$$

- (c) (2 points) For each sector, find the point at which the WTP for land is zero (this won't be a number, but a function of the model's parameters).

$$P(X_1) = 0 = TR_1 - 30 + (A_1 - B_1 - 3)X_1$$

$$X_1 = \frac{30 - TR_1}{A_1 - B_1 - 3}$$

$$P(X_2) = 0 = TR_2 - 40 + (A_2 - B_2 - 3)X_2$$

$$X_2 = \frac{40 - TR_2}{A_2 - B_2 - 3}$$

- (d) (1 point) Interpret your answer from part C. How does the distance you calculated for sector one change with  $A_1$ ? Provide economic intuition for your answers.

$$A_1 \uparrow \quad X_1 \downarrow$$

$A_1$  determines how labor costs change as we move away from the city center. If  $A_1$  increases, then costs increase. Thus the sector would not be willing to purchase land so far away.

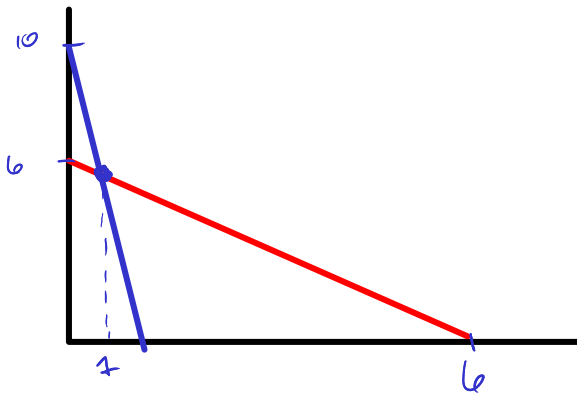
- (e) (3 points) Now assume that  $A_1 = 5$ ,  $A_2 = 6$ ,  $B_1 = 7$  and  $B_2 = 4$ . Furthermore, you may now assume that  $TR_1 = 40$  and  $TR_2 = 46$ . Draw a graph of these bid-rent curves and find the range of distances from the center each sector will be located. Remember: land is always allocated to the highest bidder. Don't worry about units and note that your answer may include fractions.

$$P(x_1) = 40 - 30 + (5 - 7 - 3)x_1$$

$$P(x_1) = 10 - 5x_1$$

$$P(x_2) = 46 - 40 + (6 - 4 - 3)x_2$$

$$P(x_2) = 6 - x_2$$



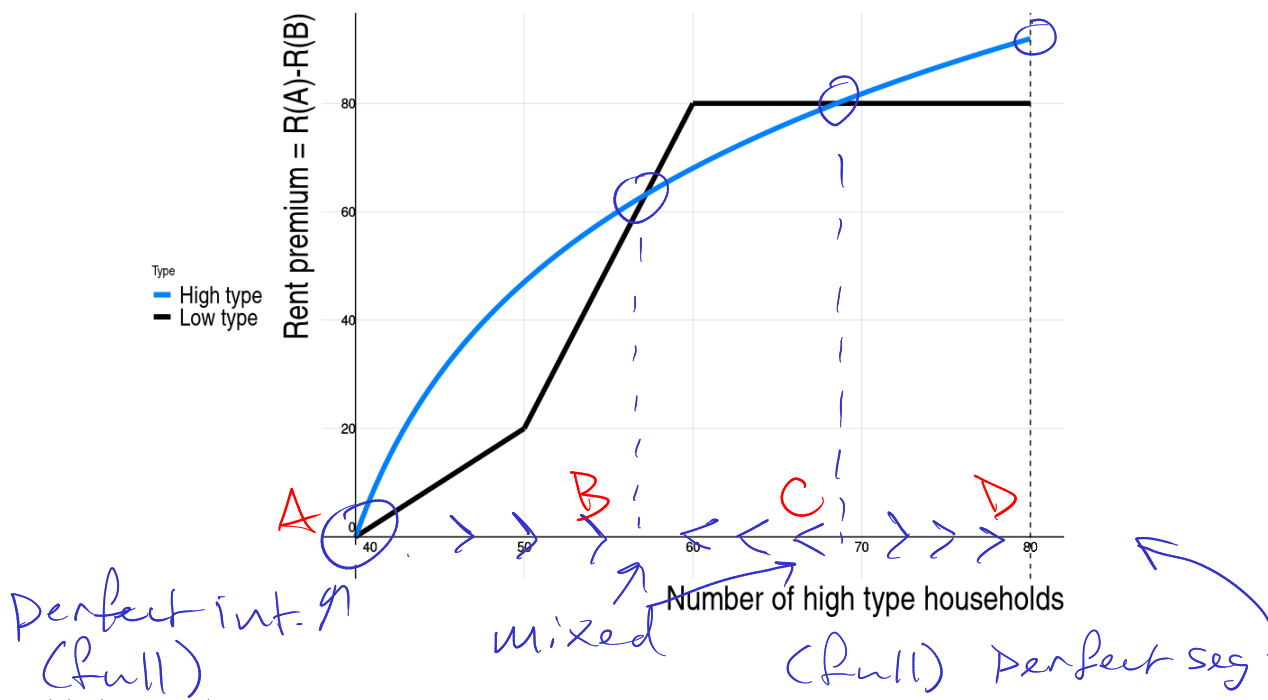
$$P(x_1) = P(x_2)$$

$$\Rightarrow 10 - 5x = 6 - x$$

$$4 = 4x$$

$$x = 1$$

7. (7 points) **Neighborhood Sorting.** Suppose we have 2 neighborhoods,  $A$  and  $B$ , each with 80 lots. Additionally, there are two types of households (HHs); high type and low type. The rent premia for living in neighborhood  $A$  is depicted by:



- (a) (3 points) On the graph, label each equilibrium point. Furthermore, label each equilibrium as either full integration, full segregation, or mixed.

- (b) (3 points) Of the equilibrium you labeled, which are stable and which are unstable? Explain.

A : Unstable perfect integration  
 B : Stable mixed eq  
 C : Unstable mixed eq  
 D : Stable perfect segregation

- (c) (1 point) Suppose neighborhood  $A$  starts with 50 residents. What equilibrium will the neighborhood reach in the long run.

B  $\approx$  57ish