

HADM 4200 Homework 1: Concepts in Urban Economics

Goal: The goal of this assignment is to cover some of the fundamental concepts in the urban economics with a focus on retail agglomeration, economies of scale, transportation costs, and bid-rent curves.

Deliverables: please submit the following files:

- **To course Gradescope:** A single PDF file containing a consolidated version of your entire Excel workbook.
 - The PDF file will be named Lastname_Firstname_HADM4200_HW1.pdf. (Insert your last and first names in the relevant spaces, e.g., Kytomaa_Lauri_HADM4200_HW1.pdf).
 - To create a PDF from your Excel file, you should first go to the “View” tab when looking at each worksheet and then enlarge the “Page Break” so that everything is on a single page. After this adjustment, simply enter printer dialogue, select Print “Entire Workbook”, and then save to PDF instead of physically printing the document.
 - You must select the relevant pages for each of the questions to help ensure timely grading.
- **To course Canvas:** A single Excel workbook containing your work and answers.
 - You should create four separate tabs (one for question 1, one for question 2, and one for each part of question 3). The tabs should be labeled “Q1,” “Q2,” and “Q3”.
 - The Excel file will be named Lastname_Firstname_HADM4200_HW1.xlsx. (Insert your last and first names in the relevant spaces, e.g., Kytomaa_Lauri_HADM4200_HW1.xlsx).

Important:

- GROUP SUBMISSIONS ARE NOT PERMITTED FOR HOMEWORK ASSIGNMENTS
- SHOW YOUR WORK AS MUCH AS POSSIBLE
 - In Excel files, all work should be labeled using comments with clear formatting consistent with the course tutorials.
- DO NOT ROUND any numbers (you may format your answers in Excel such that the underlying data appear rounded, but do not actually round the answers). Rounding can make it harder for TAs to follow your work.

Question 1: Retail agglomeration (Based on Brueckner Exercise 1.3) – 35 points

Suppose that you are a developer choosing tenants for your shopping center. There are three possible tenants: a department store, a toy store, and a shoe store. If each store were to be located outside a shopping center on its own, it would earn a certain level of gross profit per year (this is the total profit before subtracting out the cost of renting out space). Each store requires a certain number of square feet of floor space to operate, which is the same regardless of whether or not it locates in your shopping center.

The relevant values for each store type are as follows:

Store	Gross profit in isolation	Required square footage
Department store	\$99,000	9,000
Toy store	\$15,000	1,000
Shoe store	\$2,250	750

When the stores are located together, each one earns a greater gross profit from additional customer traffic generated by the locations of other stores. The increase in gross profit for each store type (“affected store type”) resulting from the presence of other store types (“added store type”) is as follows:

Affected store (rows)	Added store (columns)		
	Department	Toy	Shoe
Department store	-	\$3,000	\$1,750
Toy store	\$1,500	-	\$850
Shoe store	\$850	\$1,500	-

An example of how to use the chart is as follows. If a department store and a toy store are located in the same shopping center, then the department store gains \$3,000 additional profit and the toy store gains \$1,500 additional profit.

Suppose that as the developer, you simply want to maximize the difference between the total gross profit of your tenants minus the cost of rental per year, call this net profit. **Assume in your calculations that the cost per square foot of store floor space is \$10 in a given year.**

Questions on next page

Q1 (a) Briefly describe the pattern of incremental profits that arise from other stores in the second table above (3-4 sentences). What sort of stores appear to drive up gross profits the most?

Q2 (b) Suppose that you are only going to rent out space to a single tenant. There are three types of such tenants as outlined above. Compute the gross profit minus the cost of square footage for each of the three potential tenants. Which tenant yields the highest net profit?

Q2 (c) Next compute the net profit from the various types of two-tenant shopping centers (department store plus shoe store, department store plus toy store, and so on). How many possible options are there?

Q3 (d) Finally compute the net profits from the single, three-tenant shopping center option.

Q3 (e) Compare your answers from (b), (c), and (d). Identify the shopping center with the highest net profit. How does this relate to your answer in (a)?

Question 2: Bid-rents (Based on Ling & Archer Chapter 5) – 30 Points

The bid-rent model is a canonical model for thinking about how urban land value is determined. In this problem, we will think of a city as a one-dimensional line starting from the central business district (“CBD”) and moving out to three distinct residential areas, labeled “A1”, “A2”, and “A3” respectively. Residential areas determine how far an individual is from the CBD in which they work. For this problem, we will assume that residential areas only differ by their distance from the CBD as shown in Figure 1 below. Initially, we will assume that all residential areas are otherwise identical (same housing stock, school quality, selection of amenities).

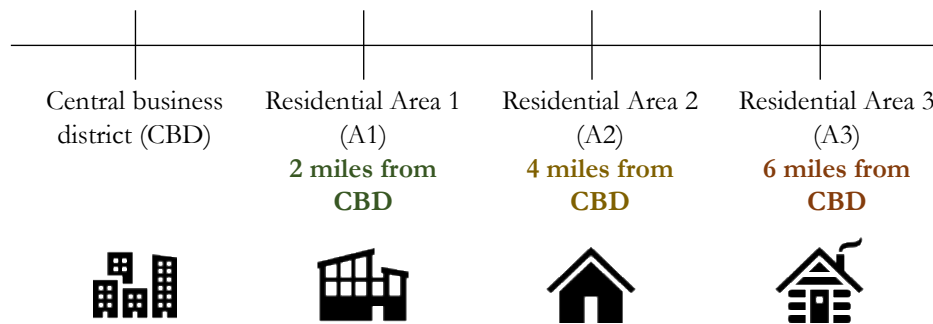


Figure 1: One-dimensional city

This one-dimensional city is a little bit old school - five days a week, residents travel from their home area to the CBD to complete an eight-hour workday, and then return home at night.

Q2 (a) Assume that all individuals in this city earn \$30 per hour as a part of their work and that everyone commutes at a speed of 15 miles per hour (on their bikes).

What is the round-trip cost of daily travel from each residential area to the CBD? Create a line graph of the monthly bid-rent line with respect to distance from CBD. *See Exhibit 5-2 for an example of this graph.*

Q2 (b) Assuming 48 work weeks in a year, what is the annual cost of travel from each residential area? How much more are households willing to pay annually to move from A3 to A1 to reduce their cost of travel?

Q2 (c) Now assume that every company in the CBD has decided to switch to a hybrid work model in which employees only need to come to work three days a week. Re-do your analysis from (b) assuming that residents only need to commute to work three days a year. What is the difference between A3 and A1 now? What are the implications of hybrid working for the bid-rent curve? Keep your answer concise.

Q2 (d) Revert back to the 5-day work week, but now we have two different types of consumers in the city – walkers and bikers. Walkers fear the speeds of biking and are willing to bid more on housing to ensure that they have a reasonable commute. Walkers can only commute at a speed of 3 miles per hour, while bikers can commute at the original 15 miles per hour. Assume that walkers outbid bikers for living in A1. How much more would a walker be willing to pay in rent to live in the CBD? Create a line graph of the monthly bid-rent line.

Question 3: Economies of scale – 35 points

Suppose that you and your business partner have just launched a new automobile company that will sell one mid-tier model under your brand name “Aviato”. Through your collective charisma, you and your partner have successfully raised sufficient venture capital funds to get the company off the ground.

The next step in your work is to figure out the optimal size and number of factories that you should build in order to produce your vehicle. The table below provides the five potential options for the manufacturing operation:

	Workers	Total output
Factory size option 1	5	0.46
... option 2	10	3.65
option 3	25	27.03
option 4	50	96.25
option 5	125	228.91

Q2 (a) Using the table above, calculate:

- i. The output per worker at each factory in the five options.
- ii. Assuming you have 250 employees, how many total factories will you have under each of the five options?
- iii. The total output for all factories under each option. Which factory size configuration yields the highest total output?

In addition to the total output, you need to factor in the cost of the individual factories that you are building. Assume that the fixed cost of building an individual factory is \$500,000 and that you must also pay an additional \$20,000 for each individual worker at the factory. So for example, a 10-worker factory would cost you $\$500,000 + 10 * (\$20,000) = \$700,000$.

Q2 (b) Given what you know about the cost of building factories:

- i. What is the cost per factory under each of the factory size options?
- ii. What is the total cost of factories (use your answer from a.ii.)?

Finally, you and your partner need to factor in the revenue that you will earn from producing the automobiles. Suppose that there is so much public hype about your new “Aviato” model that you know that every vehicle that you produce will be sold, and each car will sell for \$25,000.

Q2 (c) Using your calculations from (a) and (b), in addition to the car price, find the profit from each factory configuration with the fixed 250 employees. How many factories should you produce? Remember that profit here is given by:
(Total revenue) – (Total cost of factories).

Q2 (d) Briefly discuss your solution (2-4 sentences). Was the highest producing arrangement also profit maximizing?